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(54) **SYSTEMS AND METHODS FOR PROVIDING EXTENDED PEERING**

(75) Inventors: **Craig M. Sandin**, San Jose, CA (US); **Robin Q. Chung**, Milpitas, CA (US); **Adele M. Newman**, Mountain View, CA (US)

(73) Assignee: **Verizon Business Global LLC**, Basking Ridge, NJ (US)

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(51) **Int. Cl.**
G06F 15/16 (2006.01)
G06F 15/173 (2006.01)

(52) **U.S. Cl.** **709/206**; 709/224

(58) **Field of Classification Search** 709/224, 709/206

See application file for complete search history.

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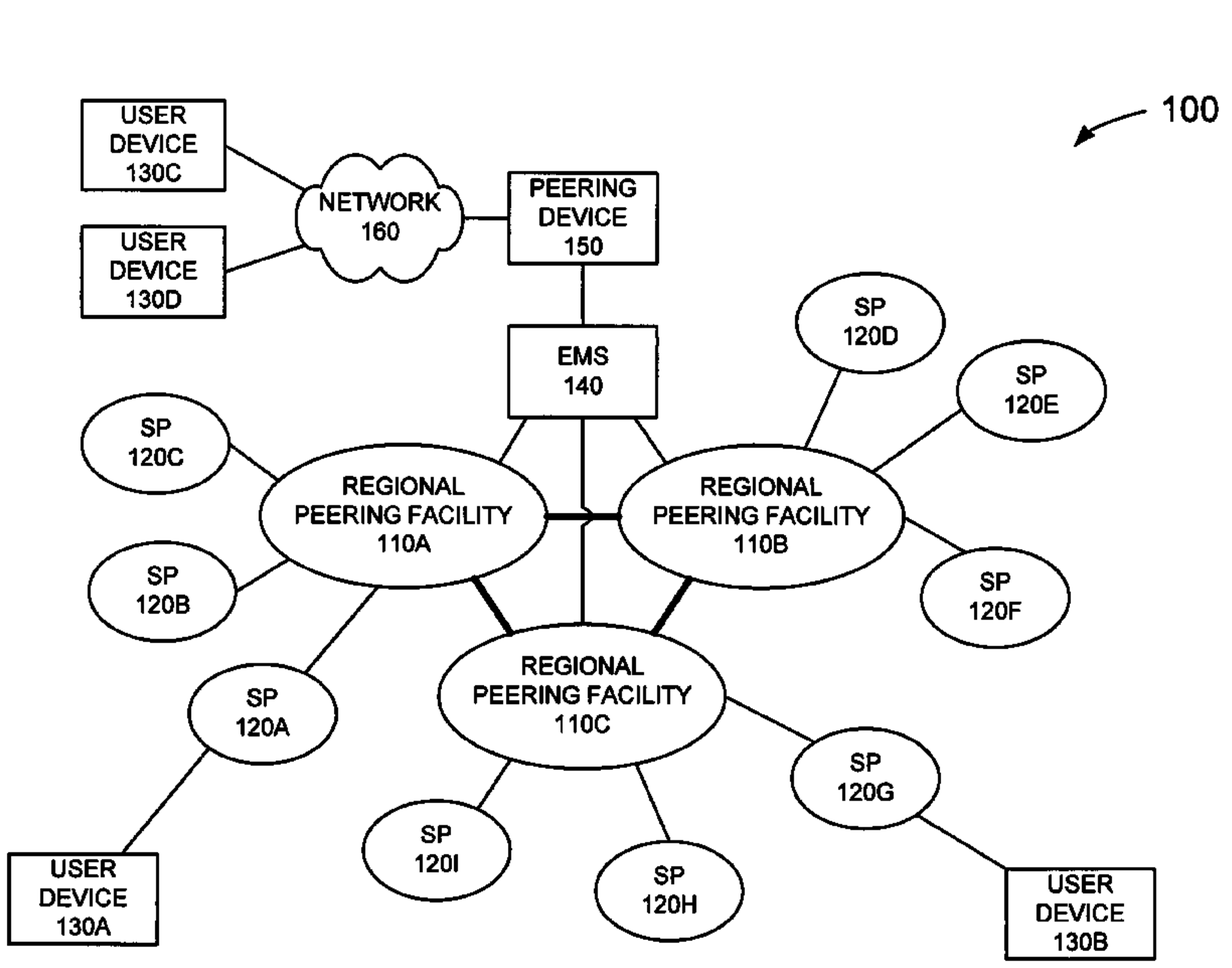
Primary Examiner — Karen Tang

(57) **ABSTRACT**

A system includes at least one network device that allows users to establish peering connections between ports in different geographic locations via web-based interfaces.

29 Claims, 12 Drawing Sheets



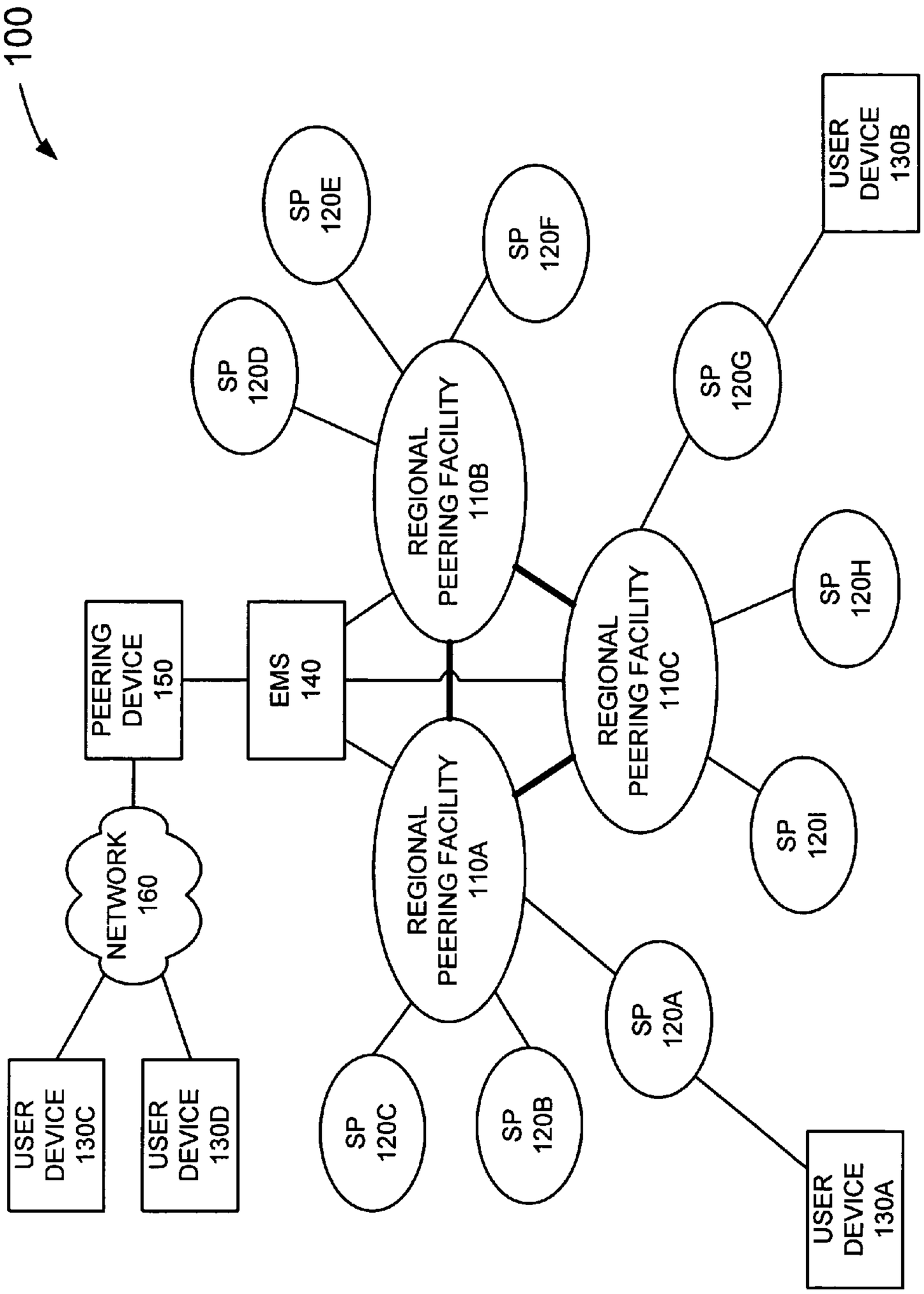

100
SP 120E
SP 120F
USER DEVICE 130B
SP 120D
REGIONAL PEERING FACILITY 110B
SP 120G
PEERING DEVICE 150
EMS 140
REGIONAL PEERING FACILITY 110C
SP 120H
NETWORK 160
REGIONAL PEERING FACILITY 110A
SP 120I
SP 120A
USER DEVICE 130C
USER DEVICE 130D
SP 120C
SP 120B
USER DEVICE 130A

FIG. 1

FIG. 2

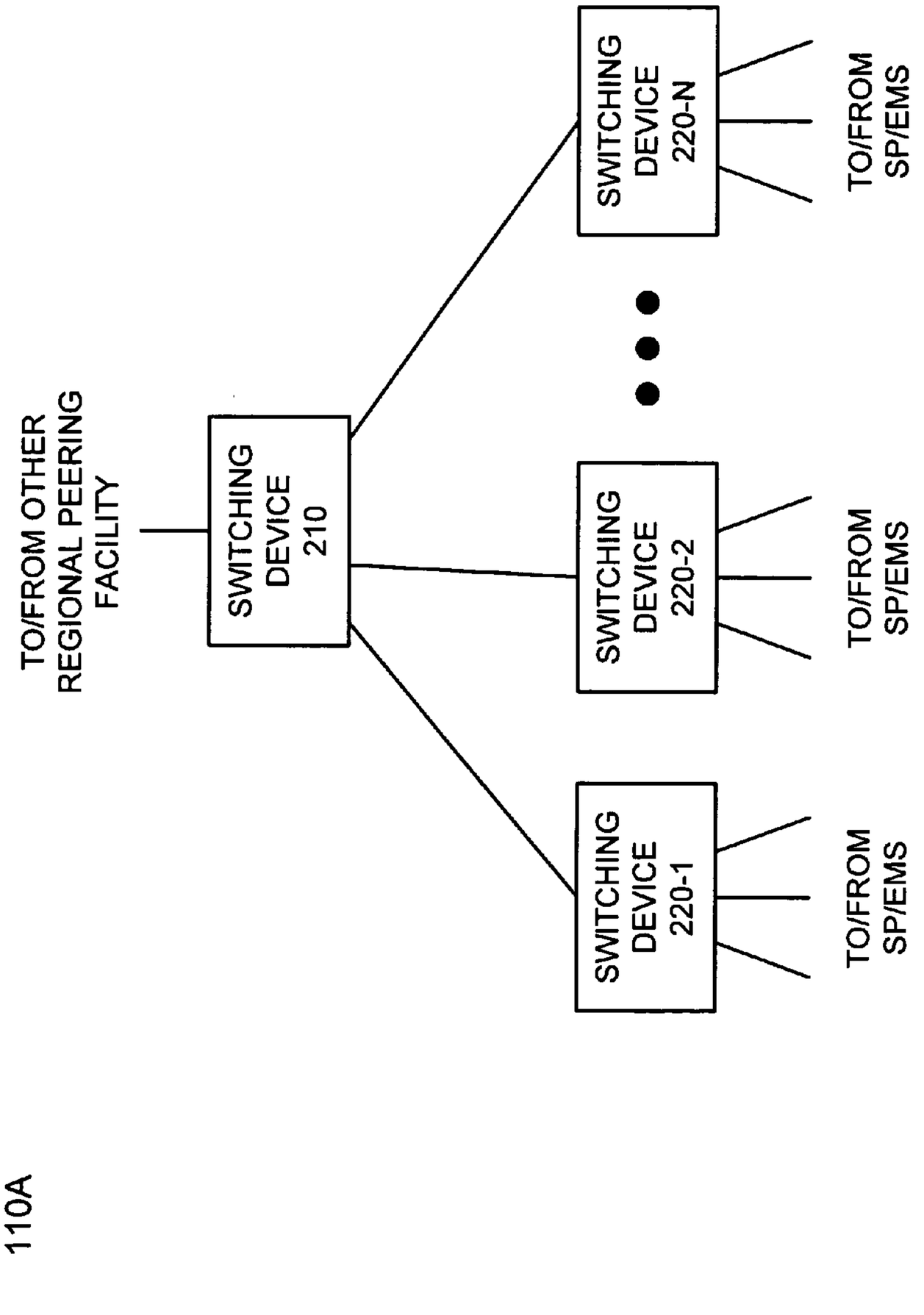
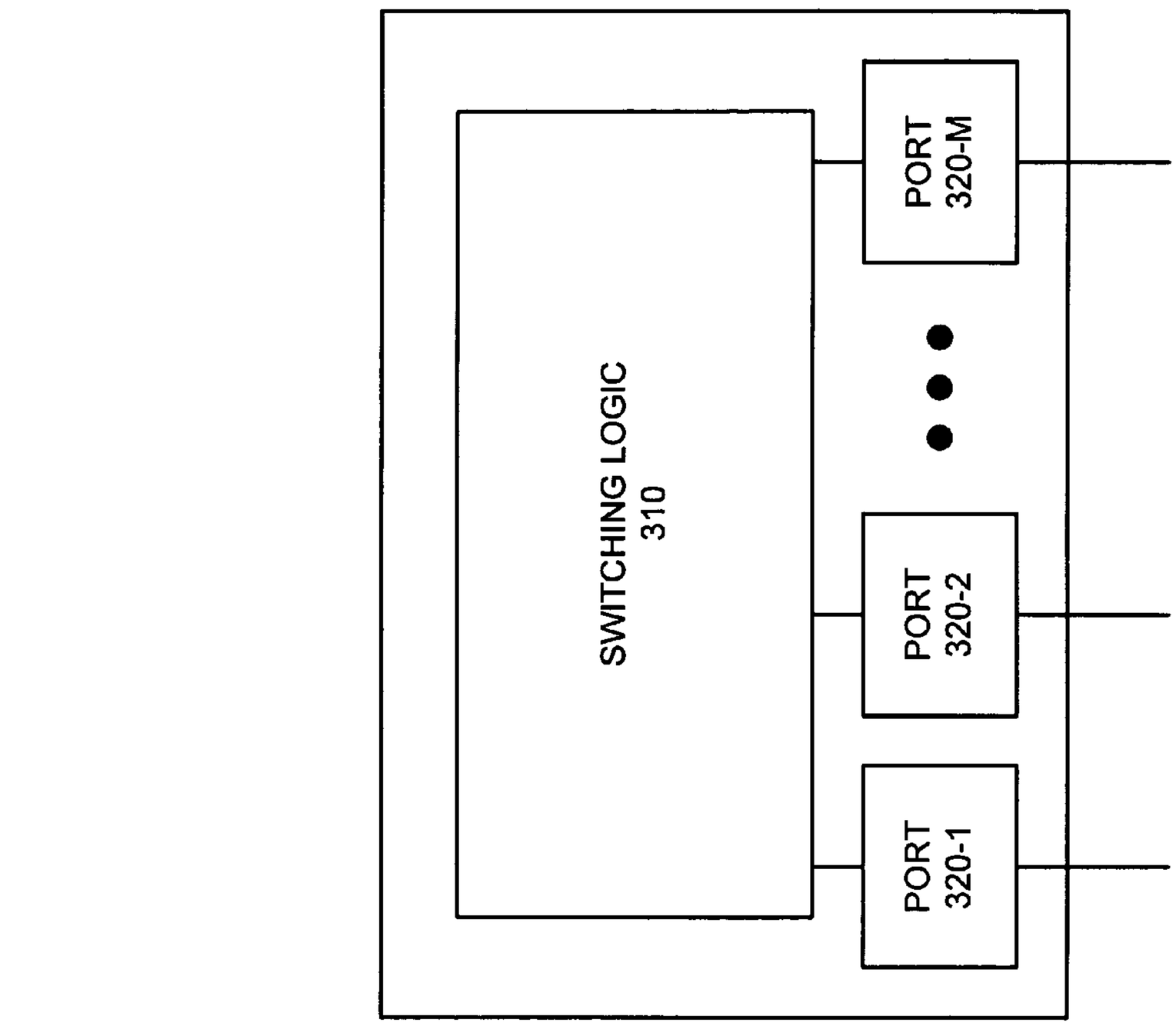

REGIONAL PEERING FACILITY 110A
TO/FROM OTHER REGIONAL PEERING FACILITY
SWITCHING DEVICE 210
SWITCHING DEVICE 220-1
SWITCHING DEVICE 220-2
SWITCHING DEVICE 220-N
TO/FROM SP/EMS
TO/FROM SP/EMS
TO/FROM SP/EMS

FIG. 3


SWITCHING DEVICE 220-1
SWITCHING LOGIC 310
PORT 320-M
PORT 320-2
PORT 320-1

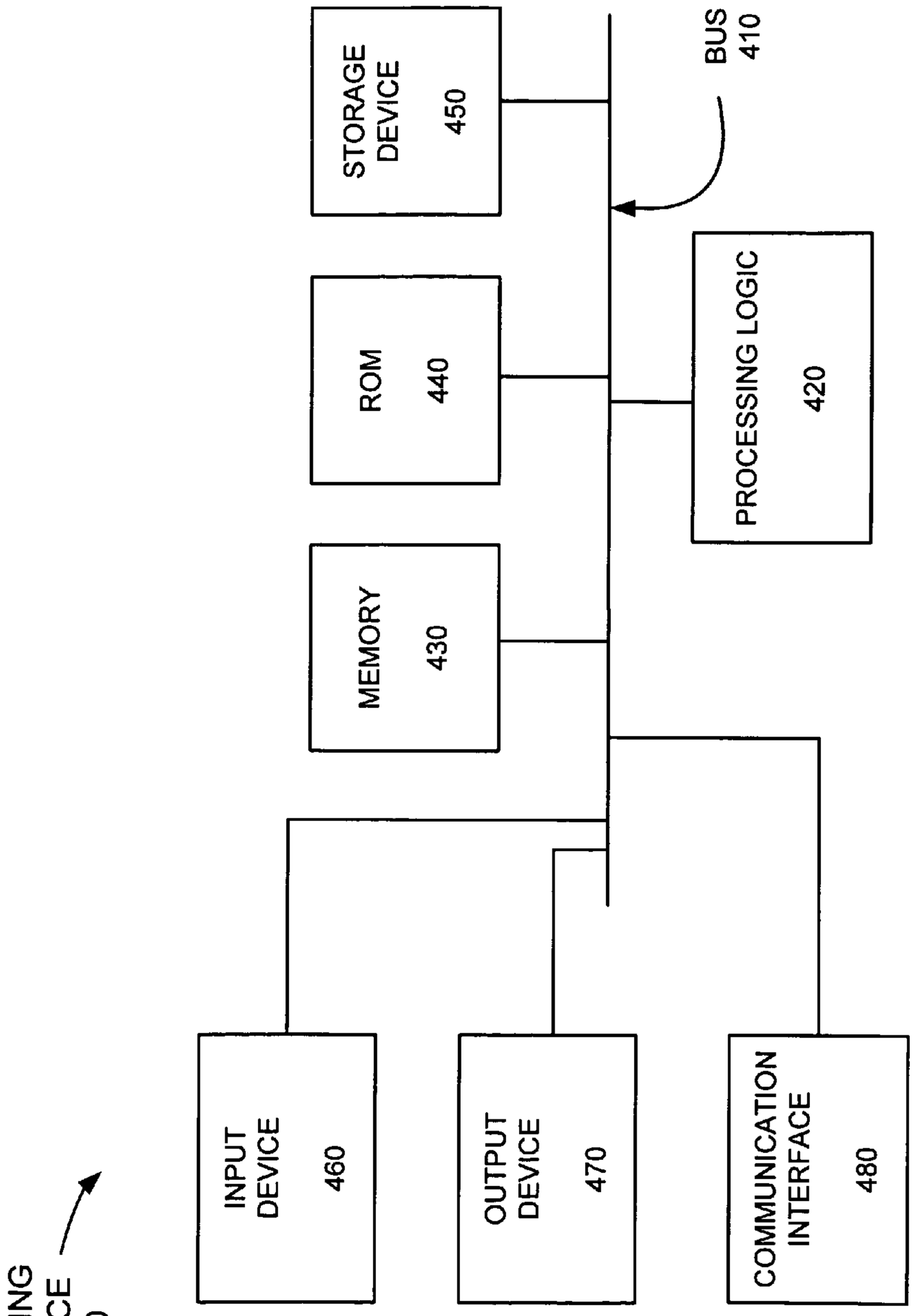

STORAGE DEVICE 450
BUS 410
ROM 440
PROCESSING LOGIC 420
MEMORY 430
INPUT DEVICE 460
OUTPUT DEVICE 470
COMMUNICATION INTERFACE 480
PEERING DEVICE 150

FIG. 4

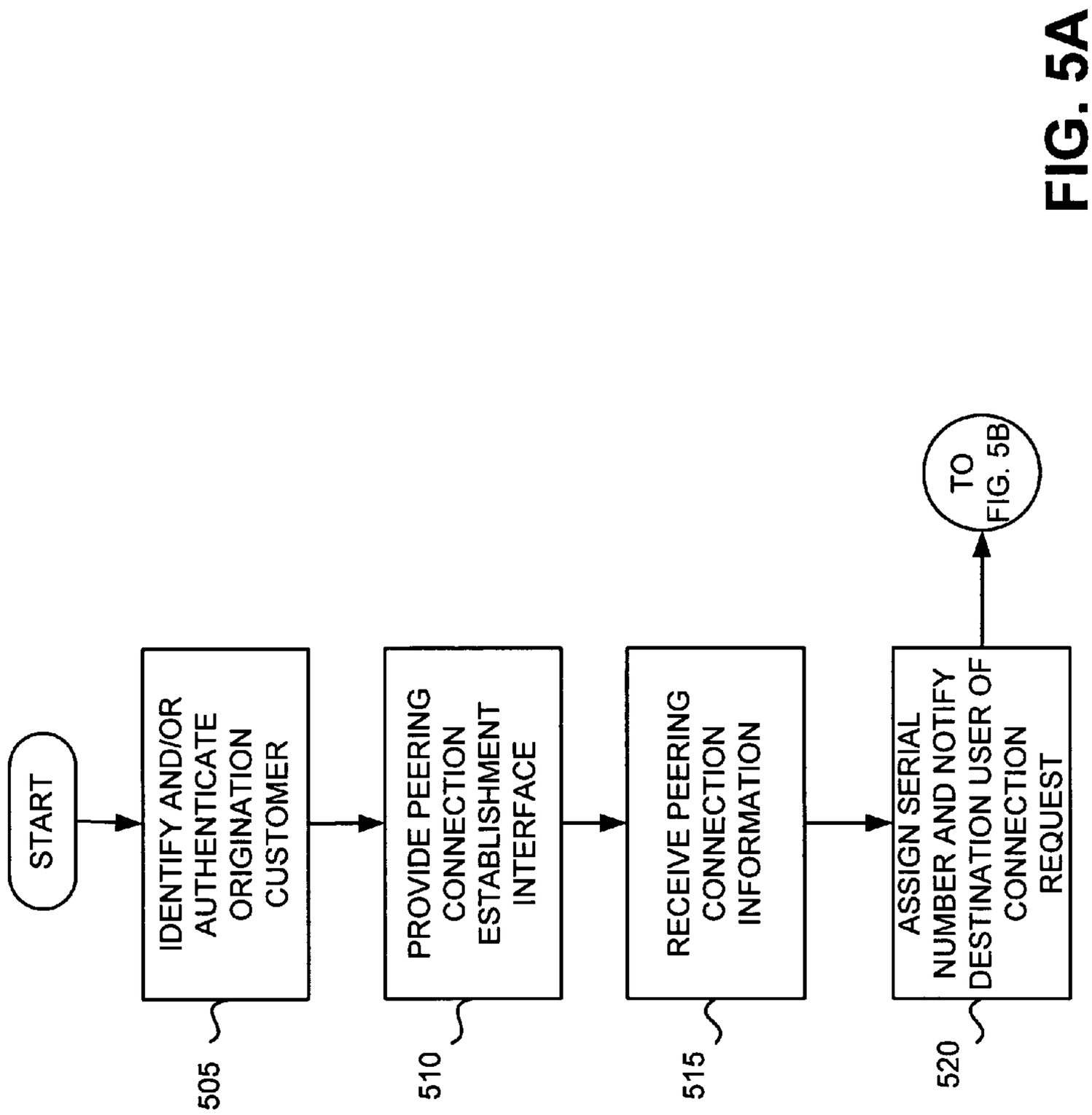

START
IDENTIFY AND/OR AUTHENTICATE ORIGINATION CUSTOMER
505
PROVIDE PEERING CONNECTION ESTABLISHMENT INTERFACE
510
RECEIVE PEERING CONNECTION INFORMATION
515
ASSIGN SERIAL NUMBER AND NOTIFY DESTINATION USER OF CONNECTION REQUEST
520
TO FIG. 5B

FIG. 5A

FIG. 5B

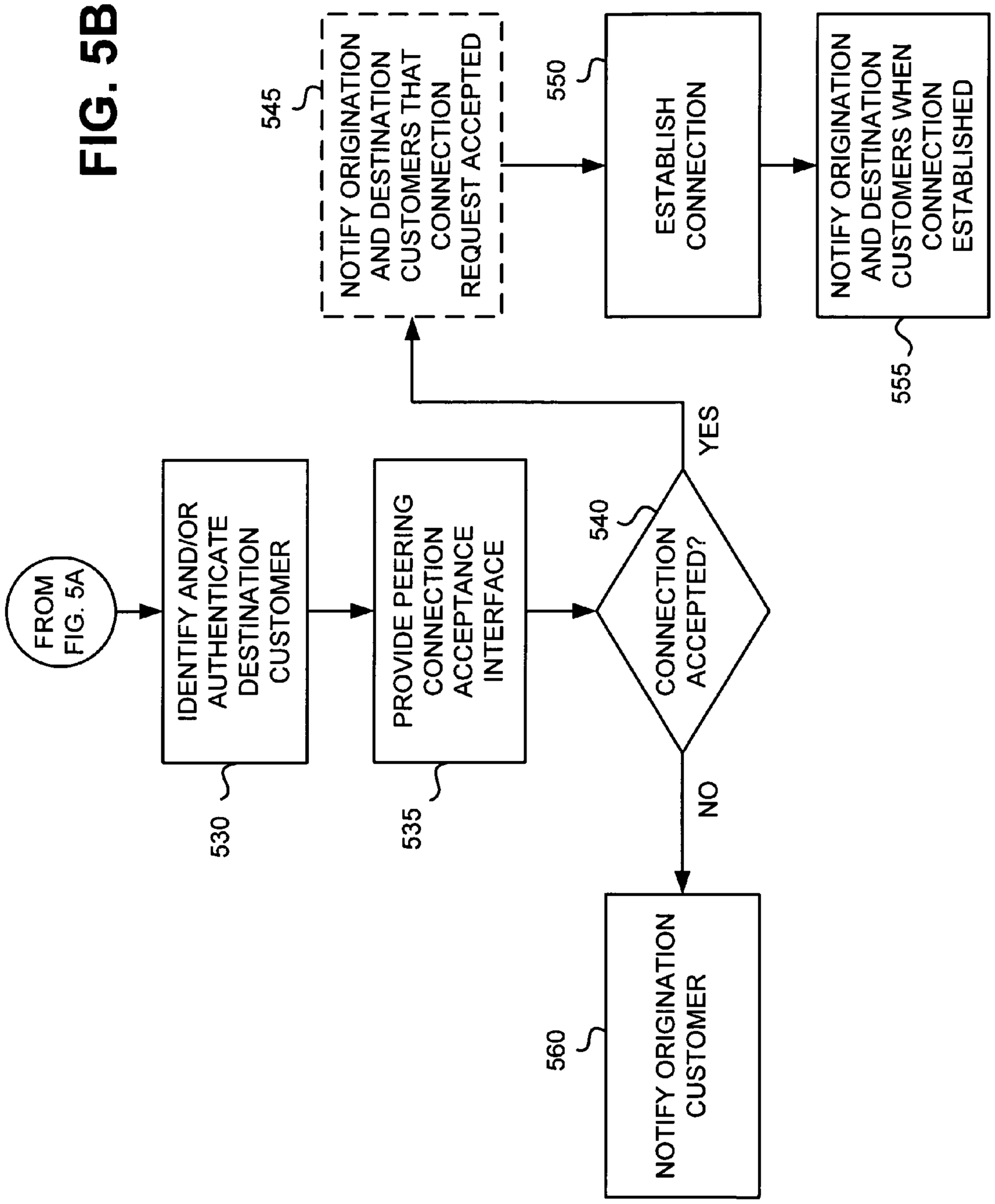
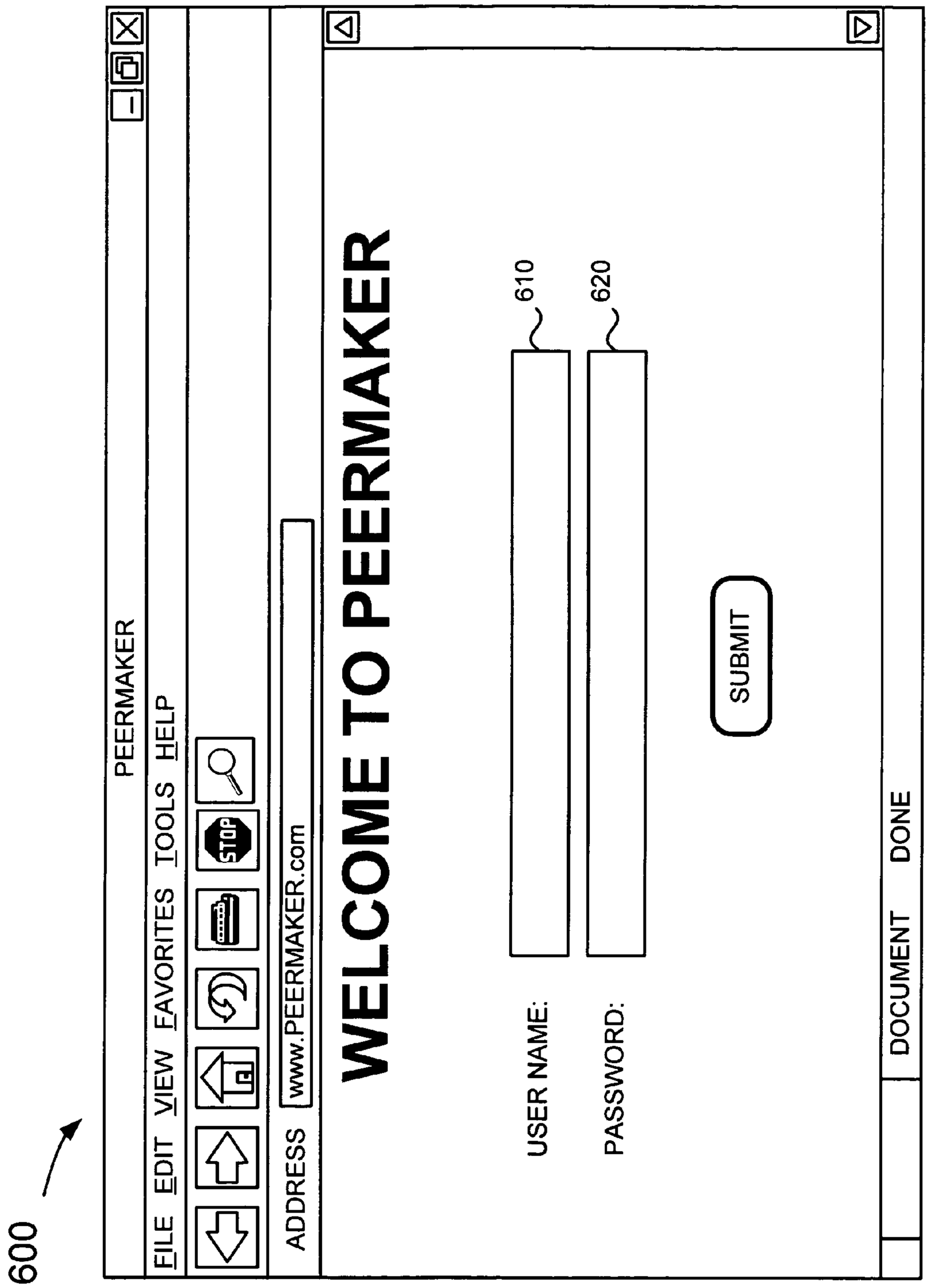

FROM FIG. 5A
IDENTIFY AND/OR AUTHENTICATE DESTINATION CUSTOMER
530
PROVIDE PEERING CONNECTION ACCEPTANCE INTERFACE
535
CONNECTION ACCEPTED?
540
YES
NO
NOTIFY ORIGINATION AND DESTINATION CUSTOMERS THAT CONNECTION REQUEST ACCEPTED
545
ESTABLISH CONNECTION
550
NOTIFY ORIGINATION AND DESTINATION CUSTOMERS WHEN CONNECTION ESTABLISHED
555
NOTIFY ORIGINATION CUSTOMER
560

FIG. 6


600
PEERMAKER
FILE EDIT VIEW FAVORITES TOOLS HELP
ADDRESS www.PEERMAKER.com
WELCOME TO PEERMAKER
610
620
USER NAME:
PASSWORD:
SUBMIT
DOCUMENT DONE

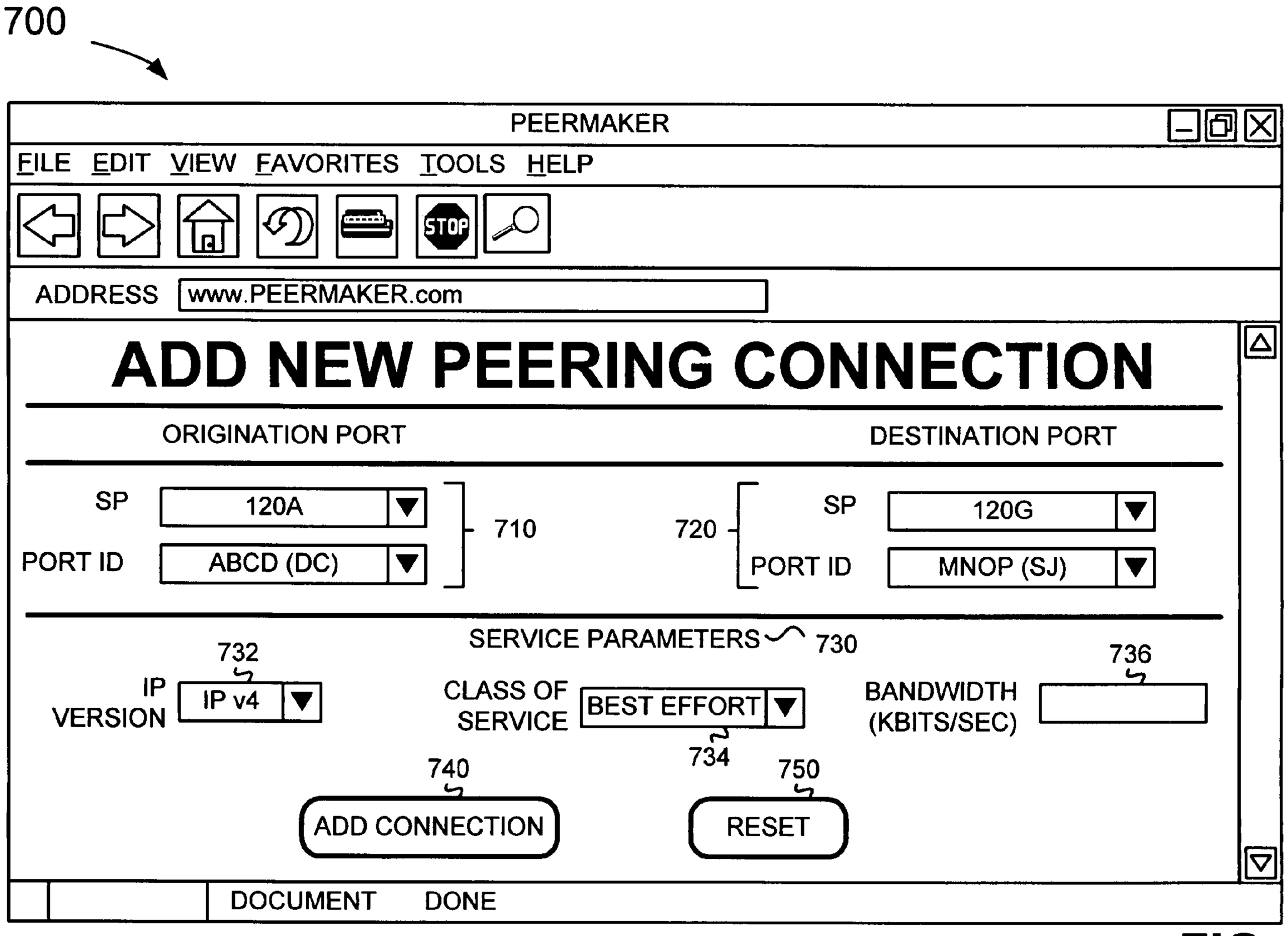

700
PEERMAKER
FILE EDIT VIEW FAVORITES TOOLS HELP
STOP
ADDRESS www.PEERMAKER.com
ADD NEW PEERING CONNECTION
ORIGINATION PORT
DESTINATION PORT
SP 120A
PORT ID ABCD (DC)
710
720
SP 120G
PORT ID MNOP (SJ)
SERVICE PARAMETERS 730
732
IP VERSION IP v4
CLASS OF SERVICE BEST EFFORT
734
BANDWIDTH (KBITS/SEC)
736
740
ADD CONNECTION
750
RESET
DOCUMENT DONE

FIG. 7

800

Request for New Connection

SERIAL NUMBER: 1234567890

CONNECTION FROM SP 120A TO SP 120G

FROM: SP: 120A; Port ID: ABCD; DLCI 601
(601 IS THE LOCAL DLCI TO CONFIGURE INTO SP 120A'S BORDER ROUTER FOR THIS CONNECTION)

TO: SP: 120G; Port ID: MNOP; VLAN ID 101
(101 IS THE LOCAL VLAN ID TO CONFIGURE INTO SP 120G'S BORDER ROUTER FOR THIS CONNECTION)

CONNECTION TYPE: EXTENDED PEERING (DC-SJ)

SERVICE CLASS: BEST EFFORT

IP VERSION: IPv4

TO ACCEPT THIS REQUEST, CLICK HERE: WWW.PEERMAKER.COM

NOTE: THE ABOVE PENDING REQUEST WILL BE CANCELED AUTOMATICALLY WITHIN 45 DAYS

FIG. 8

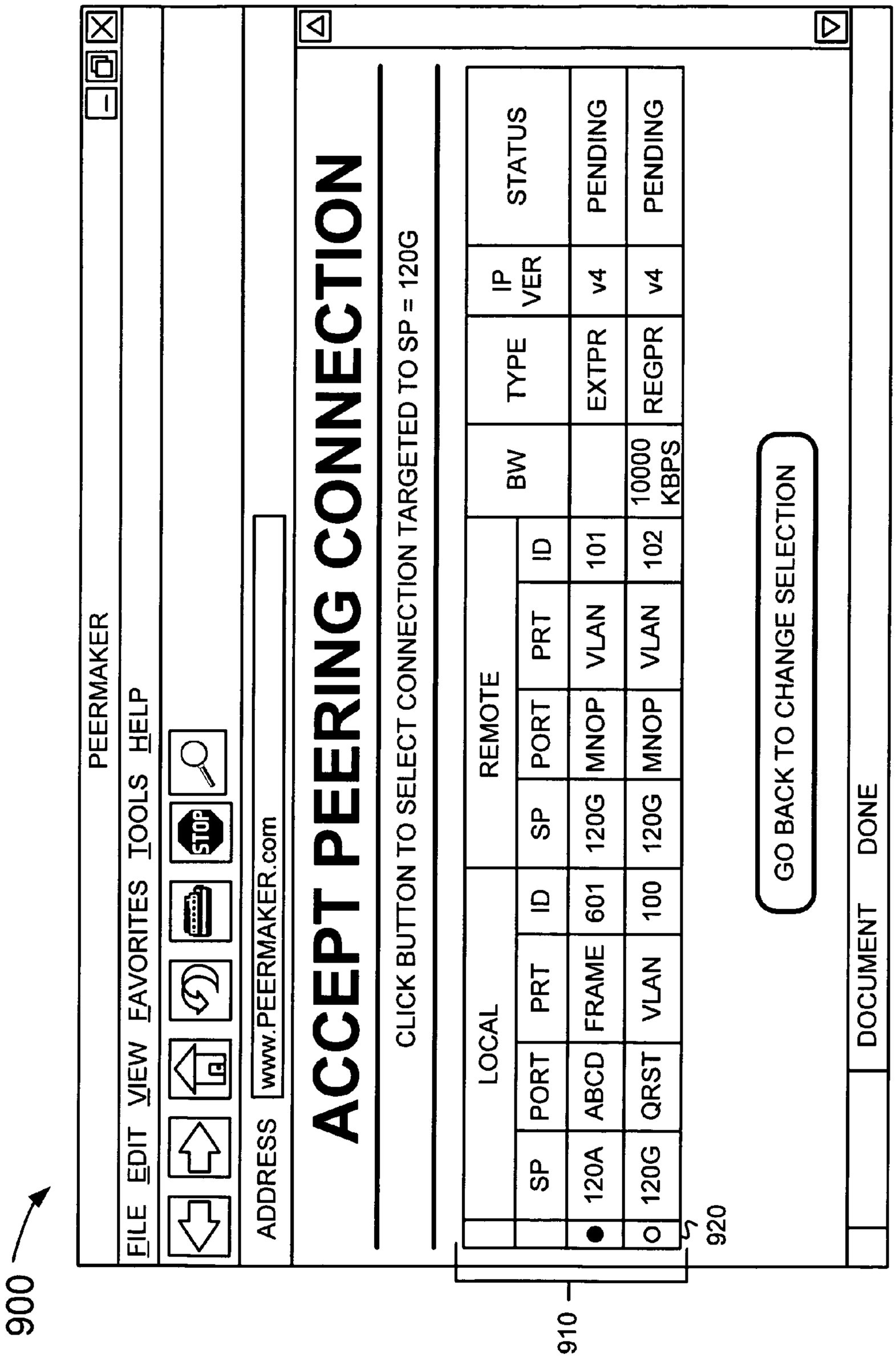

900
PEERMAKER
FILE EDIT VIEW FAVORITES TOOLS HELP
ADDRESS www.PEERMAKER.com
ACCEPT PEERING CONNECTION
CLICK BUTTON TO SELECT CONNECTION TARGETED TO SP = 120G
LOCAL
REMOTE
SP PORT PRT ID BW TYPE IP VER STATUS
120A ABCD FRAME 601 PENDING
120G MNOP VLAN 101 EXTPR v4 PENDING
120G MNOP VLAN 102 10000 KBPS REGPR v4
910
920
GO BACK TO CHANGE SELECTION
DONE
DOCUMENT

FIG. 9

1000

Accepted New Connection

SERIAL NUMBER: 1234567890

CONNECTION FROM SP 120A TO SP 120G

FROM: SP: 120A; Port ID: ABCD; DLCI 601
(601 IS THE LOCAL DLCI TO CONFIGURE INTO SP 120A'S BORDER ROUTER FOR THIS CONNECTION)

TO: SP: 120G; Port ID: MNOP; VLAN ID 101
(101 IS THE LOCAL VLAN ID TO CONFIGURE INTO SP 120G'S BORDER ROUTER FOR THIS CONNECTION)

CONNECTION TYPE: EXTENDED PEERING (DC-SJ)

SERVICE CLASS: BEST EFFORT

IP VERSION: IPv4

FIG. 10

1100

Establishment of New Connection Successful

SERIAL NUMBER: 1234567890

A CONNECTION WAS ESTABLISHED FROM SP 120A TO SP 120G

FROM: SP: 120A; Port ID: ABCD; DLCI 601
(601 IS THE LOCAL DLCI TO CONFIGURE INTO SP 120A'S BORDER ROUTER FOR THIS CONNECTION)

TO: SP: 120G; Port ID: MNOP; VLAN ID 101
(101 IS THE LOCAL VLAN ID TO CONFIGURE INTO SP 120G'S BORDER ROUTER FOR THIS CONNECTION)

CONNECTION TYPE: EXTENDED PEERING (DC-SJ)

SERVICE CLASS: BEST EFFORT

IP VERSION: IPv4

FIG. 11

SYSTEMS AND METHODS FOR PROVIDING EXTENDED PEERING

FIELD OF THE INVENTION

Implementations consistent with the principles of the invention relate generally to communications networks and, more particularly, to systems and methods for providing extended peering in communications networks.

BACKGROUND OF THE INVENTION

Establishment of peering connections is quite common. A peering connection is a persistent connection between a service provider (SP), such as an Internet Service Provider (ISP), associated with a first customer and the SP associated with another customer that provides reliable and ordered transfers of data. A company may, for example, establish a peering connection between its main office and a satellite office to enable employees at the satellite office to access and retrieve files from devices attached to the main office's network, as if they were physically attached to that network. Establishment of peering connections is typically cumbersome and often requires an experienced network administrator.

SUMMARY OF THE INVENTION

In an implementation consistent with the principles of the invention, a method includes receiving a request from a first customer via a web-based interface. The request identifies a peering connection between a first port associated with the first customer and located in a first geographical region and a second port associated with a second customer and located in a second, different geographical region. The method further includes establishing the peering connection based on the received request.

In another implementation consistent with the principles of the invention, a system includes a network device. The network device is configured to cause a web-based interface to be provided to a user device, where the web-based interface allows a user to request that an extended peering connection be established; receive information from the user relating to the extended peering connection; and cause the extended peering connection to be established between the user and a second user based on the received information.

In still another implementation consistent with the principles of the invention, a method includes causing a graphical user interface to be provided to a user device, where the graphical user interface allows a user to request that a peering connection be established between two ports located in different geographic regions; receiving information relating to the peering connection from the user device; and establishing the peering connection between the two ports based on the received information.

In a further implementation consistent with the principles of the invention, a system includes at least one network device that allows users to establish peering connections between ports in different geographic locations via web-based interfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate an embodiment of the invention and, together with the description, explain the invention. In the drawings,

FIG. **1** illustrates an exemplary system in which systems and methods, consistent with the principles of the invention, may be implemented;

FIG. **2** illustrates an exemplary configuration of a regional peering facility in an exemplary implementation consistent with the principles of the invention;

FIG. **3** illustrates an exemplary configuration of a switching device in an exemplary implementation consistent with the principles of the invention;

FIG. **4** illustrates an exemplary configuration of a peering device in an implementation consistent with the principles of the invention;

FIGS. **5**A and **5**B illustrate an exemplary process for establishing an extended peering connection in an implementation consistent with the principles of the invention;

FIG. **6** illustrates an exemplary initial web page that may be forwarded to a user device in an implementation consistent with the principles of the invention;

FIG. **7** illustrates an exemplary peering connection establishment graphical user interface that may be presented to an origination customer in an implementation consistent with the principles of the invention;

FIG. **8** illustrates an exemplary e-mail notification that may be sent to a customer in an implementation consistent with the principles of the invention;

FIG. **9** illustrates an exemplary peering connection acceptance graphical user interface that may be presented to a destination customer in an implementation consistent with the principles of the invention;

FIG. **10** illustrates another exemplary e-mail notification that may be sent to a customer in an implementation consistent with the principles of the invention; and

FIG. **11** illustrates yet another exemplary e-mail notification that may be sent to a customer in an implementation consistent with the principles of the invention.

DETAILED DESCRIPTION

The following detailed description of implementations consistent with the principles of the invention refers to the accompanying drawings. The same reference numbers in different drawings may identify the same or similar elements. Also, the following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims and their equivalents.

Implementations consistent with the principles of the invention provide extended peering capabilities in a communications network. Extended peering allows a customer to peer with other customers regardless of where the other customers are located. In one implementation, the customer may build and maintain peering connections with other customers using, for example, web-based graphical user interfaces.

Exemplary System

FIG. **1** illustrates an exemplary system **100** in which systems and methods, consistent with the principles of the invention, may be implemented. As illustrated, system **100** may include regional peering facilities **110**A-**110**C (referred to collectively as "peering facilities **110**"), service providers (SPs) **120**A-**120**I (referred to collectively as "SPs **120**"), user devices **130**A-**130**D (referred to collectively as "user devices **130**"), an element management system (EMS) **140**, a peering device **150**, and a network **160**. The number of regional peering facilities **110**, SPs **120**, user devices **130**, EMSs **140**, and peering devices **150** illustrated in FIG. **1** is provided for simplicity. In practice, a typical system could include more or

fewer regional peering facilities **110**, SPs **120**, user devices **130**, EMSs **140**, and peering devices **150** than illustrated in FIG. **1**.

Regional peering facilities **110** may include one or more devices that facilitate the transfer of data between network devices, such as SPs **120**. In one implementation, each regional peering facility **110**A-**110**C is associated with a different geographic region (e.g., one may be located on the east coast of the United States or a particular region within the eastern part of the United States and another may be located on the west coast or a particular region within the western part of the United States) and acts as a point of presence (POP) for that region by interconnecting various data networks and SPs **120**. In one exemplary implementation consistent with the principles of the invention, each regional peering facility **110**A-**110**C may include a Metropolitan Area Exchange (MAE®) Internet Exchange Point.

SPs **120** may include one or more devices that provide network access to customers via, for example, user devices **130**. In one implementation, one or more of SPs **120** may include Internet Service Providers (ISPs). Each SP **120**A-**120**I may include, for example, one or more routing devices, security devices, such as firewalls, and/or other common devices for providing network access to customers.

User devices **130** may include devices, such as personal computers, mainframe computers, servers, lap tops, personal digital assistants (PDAs), wireless telephones, etc., threads or processes running on these devices or other types of devices, and/or objects executable by these devices. In one implementation, user devices **130** may allow customers to establish and maintain peering connections with other customers in system **100**. For example, a customer at a user device **130**A-**130**D can establish a peering connection between a pair of SPs. It will be appreciated based on the description below that the user can establish the peering connection via any of user devices **130**A-**130**D. For explanatory purposes, it is assumed that a user (referred to hereinafter as an "origination customer") at user device **130**C establishes a peering connection between SP **120**A and SP **120**G.

EMS **140** may include one or more network devices that receive data from regional peering facilities **110** and route the data to peering device **150**. EMS **140** may also receive data from peering device **150** and route the data to the appropriate regional peering facility or facilities.

Peering device **150** may include one or more types of computer systems, such as a mainframe, minicomputer, or personal computer. In one implementation consistent with the principles of the invention, peering device **150** may include one or more servers. Peering device **150** may receive peering connection requests from user devices **130** and cause peering connections to be established based on the requests. While shown as located external to regional peering facilities **110**, in other implementations, peering device **150** may be located in one or more of regional peering facilities **110**.

Network **160** may include a local area network (LAN), a wide area network (WAN), a telephone network, such as the Public Switched Telephone Network (PSTN), an intranet, the Internet, or a combination of networks.

Regional peering facilities **110**, SPs **120**, user devices **130**, EMS **140**, and peering device **150** may connect to each other via wired, wireless, and/or optical connections.

Exemplary Configuration of a Regional Peering Facility

FIG. **2** illustrates an exemplary configuration of a regional peering facility, such as regional peering facility **110**A, in an exemplary implementation consistent with the principles of the invention. Regional peering facilities **110**B and **110**C may be similarly configured.

As illustrated, regional peering facility **110**A may include switching devices **210** and **220**-**1** through **220**-N (referred to collectively as "switching devices **220**"). The number of switching devices **210**/**220** illustrated in FIG. **2** is provided for simplicity. In practice, a typical regional peering facility **110**A could include more or fewer switching devices **210**/**220**. Moreover, it will be appreciated that the configuration illustrated in FIG. **2** is purely exemplary. Also, regional peering facility **110**A may include other devices that aid in receiving, processing, and/or transmitting data.

Switching device **210** may connect to switching devices **220** and one or more other regional peering facilities **110**. Switching device **210** may include one or more devices for receiving data from switching devices **220** and forwarding the data to the appropriate regional peering facility **110**B/**110**C. Switching device **210** may also include one or more devices for receiving data from a regional peering facility **110**B/**110**C and forwarding the data to the appropriate switching device **220**-**1** through **220**-N.

Switching devices **220** may connect to switching device **210** and to customers' devices, such as user devices **130**, via SPs **120**. Switching devices **220** may also connect to EMS **140**. Each switching device **220**-**1** through **220**-N may include one or more devices for receiving data from an SP **120**A-**120**I and forwarding the data to switching device **210** or EMS **140**. Each switching device **220**-**1** through **220**-N may also include one or more devices for receiving data from switching device **210** or EMS **140** and forwarding the data to the appropriate SP **120**A-**120**I.

FIG. **3** illustrates an exemplary configuration of a switching device, such as switching device **220**-**1**, in an exemplary implementation consistent with the principles of the invention. Switching devices **220**-**2** through **220**-N and switching device **210** may be similarly configured.

As illustrated, switching device **220**-**1** may include switching logic **310** and a number of ports **320**-**1** through **320**-M (referred to collectively as "ports **320**"). The number of devices (i.e., switching logic and ports) illustrated in FIG. **3** is provided for simplicity. In practice, a typical switching device **220**-**1** could include more or fewer devices. Moreover, it will be appreciated that the configuration illustrated in FIG. **3** is purely exemplary. For example, switching device **220**-**1** may include other devices that aid in receiving, processing, and/or transmitting data.

Switching logic **310** may include processing logic for processing received data and determining how and where to transfer data. For example, switching logic **310** may include one or more forwarding tables and logic for converting data from a first format to a second format.

Ports **320** may include one or more devices for receiving data from and transferring data to other network devices, such as an SP **120**A-**120**I or EMS **140**, in a well-known manner. In one implementation, SPs **120** may physically connect to ports **320**. For example, as illustrated in FIG. **1**, SP **120**A may physically connect to a port **320**-**1** through **320**-M of regional peering facility **110**A. In some implementations, a single SP **120**A-**120**I may connect to more than one port **320**-**1** through **320**-M of a regional peering facility **110**A-**110**C. Each port **320**-**1** through **320**-M may be associated with a unique identifier.

Exemplary Configuration of the Peering Device

FIG. **4** illustrates an exemplary configuration of peering device **150** in an implementation consistent with the prin-

ciples of the invention. It will be appreciated that user devices **130**A-**130**D may be similarly configured. As illustrated, peering device **150** may include a bus **410**, processing logic **420**, a memory **430**, a read only memory (ROM) **440**, a storage device **450**, an input device **460**, an output device **470**, and a communications interface **480**. It will be appreciated that peering device **150** may include other components (not shown) that aid in receiving, transmitting, and/or processing data.

Bus **410** may permit communication among the components of peering device **150**. Processing logic **420** may include any type of conventional processor or microprocessor that interprets and executes instructions. In other implementations, processing logic **420** may be implemented as or include an application specific integrated circuit (ASIC), field programmable gate array (FPGA), or the like. Memory **430** may include a random access memory (RAM) or another type of dynamic storage device that stores information and instructions for execution by processing logic **420**. ROM **440** may include a conventional ROM device and/or another type of static storage device that stores static information and instructions for the processing logic **420**. Storage device **450** may include some other type of magnetic or optical recording medium and its corresponding drive for storing information and/or instructions.

Input device **460** may include a conventional device that permits an operator to input information to peering device **150**, such as a keyboard, a keypad, a mouse, a pen, a microphone, one or more biometric mechanisms, and the like. Output device **470** may include a conventional device that outputs information to the operator, including a display, a printer, a speaker, etc.

Communication interface **480** may include any transceiver-like mechanism that enables peering device **150** to communicate with other devices and/or systems, such as user devices **130**. For example, communication interface **480** may include mechanisms for communicating with a user device **130**A-**130**D via a network, such as network **160**.

As will be described in detail below, peering device **150**, consistent with the principles of the invention, may provide graphical user interfaces to a customer associated with a user device **130**A-**130**D to allow that customer to establish and maintain peering connections. Peering device **150** may perform these and other functions in response to processing logic **420** executing software instructions contained in a computer-readable medium, such as memory **430**. A computer-readable medium may be defined as one or more memory devices and/or carrier waves. The software instructions may be read into memory **430** from another computer-readable medium, such as data storage device **450**, or from another device via communication interface **480**. The software instructions contained in memory **430** may cause processing logic **420** to perform processes that will be described later. Alternatively, hardwired circuitry may be used in place of or in combination with software instructions to implement processes consistent with the principles of the invention. Thus, systems and methods consistent with the principles of the invention are not limited to any specific combination of hardware circuitry and software.

Exemplary Processing

FIGS. **5**A and **5**B illustrate an exemplary process for establishing an extended peering connection in an implementation consistent with the principles of the invention. Processing may begin with a customer (referred to hereinafter as the "origination customer") using a user device, such as user device **130**C, wanting to establish a peering connection with another customer (referred to hereinafter as the "destination customer"). In this exemplary implementation, it is assumed that the peering connection is to be established between a port associated with SP **120**A and a port associated with SP **120**G and that these ports are located in different geographic regions and associated with different regional peering facilities **110**.

To establish the peering connection, the origination customer may access a predetermined network location associated with peering device **150** using user device **130**C. In one implementation, the predetermined network location may include a web page. The origination customer may request the web page by, for example, typing in a Uniform Resource Locator (URL) associated with the web page. In response, peering device **150** may cause an initial web page to be displayed at user device **130**C.

FIG. **6** illustrates an exemplary initial web page **600** (also called a graphical user interface) that may be forwarded to user device **130**C. As illustrated, graphical user interface **600** may include a user name field **610** and a password field **620**. User name field **610** may allow the origination customer to enter a user name. Password field **620** may allow the origination customer to enter a password. Once the origination customer has entered a name and password, the customer may click the SUBMIT button to transfer the name and password to peering device **150**.

Peering device **150** may identify and/or authenticate the origination customer (act **505**). For example, peering device **150** may compare the user name and password to a list of authorized user names and passwords. If the origination customer's user name and password pair matches a user name and password pair from the authorized list, then peering device **150** may determine that the origination customer is authorized. Peering device **150** may then cause an introductory graphical user interface to be presented to the origination customer that allows the origination customer to select a peering function to be performed. Assume that the origination customer elects to add a new peering connection.

In response, peering device **150** may cause a peering connection establishment graphical user interface to be presented to the origination customer (act **510**). FIG. **7** illustrates an exemplary peering connection establishment graphical user interface **700** that may be presented to the origination customer in an implementation consistent with the principles of the invention. As illustrated, graphical user interface **700** may include an origination port section **710**, a destination port section **720**, and a service parameters section **730**. Graphical user interface **700** may be associated with additional or other sections or fields that aid in the establishing peering connections.

Origination port section **710** may allow the origination customer to specify an SP with which the origination customer is associated and a port identifier (ID) associated with a port on the regional peering facility with which the SP is connected. In one implementation, the origination customer may specify the SP and port ID via pull-down menus. As illustrated in FIG. **7**, the origination customer has specified SP **120**A and port ID ABCD that is associated with regional peering facility **110**A. In one implementation consistent with the principles of the invention, the port ID may be associated with a regional identifier denoted in parentheses. In the example illustrated in FIG. **7**, regional peering facility **110**A is assumed to be located in the District of Columbia (denoted "DC").

Destination port section **720** may allow the origination customer to specify an SP with which the origination cus-

tomer wishes to peer. Destination port section **720** may also allow the origination customer to specify a port identifier (ID) associated with a remote port on the regional peering facility with which the destination SP is connected. In one implementation, the origination customer may specify the SP and port ID in destination port section **720** via pull-down menus. As illustrated in FIG. **7**, the origination customer has specified SP **120**G and port ID MNOP that is associated with regional peering facility **110**C. As set forth above, in one implementation consistent with the principles of the invention, the port ID may be associated with a regional identifier denoted in parentheses. In the example illustrated in FIG. **7**, regional peering facility **110**C is assumed to be located in San Jose (denoted "SJ").

Service parameters section **730** may include a protocol field **732**, a class of service field **734**, and a bandwidth field **736**. Protocol field **732** may allow the origination customer to specify a protocol to be used for communications over the new peering connection. In one implementation, the origination customer may specify the protocol via a pull-down menu. As illustrated in FIG. **7**, the origination customer has specified Internet Protocol (IP) version 4. Class of service field **734** may allow the origination customer to specify a class of service, such as priority service or best effort service, for the new peering connection. Priority service allows the customer to specify the bandwidth associated with the requested peering connection. Best effort service provides a small amount of reserved bandwidth, which may not be selectable by the customer, and a relatively large peak rate. In one implementation consistent with the principles of the invention, the origination customer may select the class of service via a pull-down menu. In some implementations, the origination customer may only make the class of service selection between priority and best effort when establishing a regional peering connection (i.e., a peering connection that utilizes a single regional peering facility). The origination customer may be provided with best effort service when establishing an extended peering connection (i.e., a peering connection that utilizes more than one regional peering facility). Bandwidth field **736** may allow the origination customer to specify a desired bandwidth. In one implementation, the origination customer may be allowed to specify a desired bandwidth when priority service has been selected in class of service field **734**. The origination customer may, for example, specify the bandwidth in kilobits per second (kbits/sec).

Once the origination customer has entered the above information for the new peering connection, the origination customer may select an ADD CONNECTION button **740** to transmit the new peering connection information to peering device **150**. Graphical user interface **700** may also include a RESET button **750** that removes the information entered in sections **710**, **720**, and **730** and returns graphical user interface **700** to its original form.

Returning to the processing described in FIGS. **5**A and **5**B, peering device **150** may receive the new peering connection request from the origination customer (act **515**, FIG. **5**A). Peering device **150** may assign a serial number to the peering connection request (act **520**). The serial number provides the origination and destination customers with a reference number that may be provided to a customer service representative in the event they are unable to establish the peering connection. Peering device **150** may notify the destination customer and, optionally, the origination customer of the origination customer's request to establish a new peering connection (act **520**). Peering device **150** may notify the origination and destination customers via any well-known technique (e.g., e-mail, facsimile, instant message, telephone, etc.). Among other things, the notification allows the destination customer to know that the origination customer wishes to establish a peering connection with the destination customer.

FIG. **8** illustrates an exemplary e-mail notification **800** that may be sent to the origination and destination customers in an implementation consistent with the principles of the invention. As illustrated, e-mail notification **800** may specify the serial number that has been assigned to this new peering connection transaction and summarize the information requested by the origination customer.

For example, e-mail notification **800** may specify the origination customer's connection information (e.g., from SP **120**A, port ID ABCD, and the origination customer's connection identifier with which a router associated with SP **120**A is to be configured). In one implementation consistent with the principles of the invention, the connection identifier may be specified as a virtual path identifier/virtual circuit identifier (VPI/VCI), a data link connection identifier (DLCI), a virtual local area network (VLAN) identifier (ID), or another type of identifier. In this example, the connection identifier for the origination customer is a DLCI with a value of 601.

E-mail notification **800** may also specify the destination customer's connection information (e.g., to SP **120**G, port ID MNOP, and the destination customer's connection identifier with which a router associated with SP **120**G is to be configured). In the example illustrated in FIG. **8**, the connection identifier for the destination customer is a VLAN ID with a value of 101.

E-mail notification **800** may specify the type of connection requested by the origination customer. In this example, since the port from which the connection is to be established and the port to which the connection is to be established are located in different geographical regions and are associated with different regional peering facilities **110**, e-mail notification **800** may specify the connection as extended peering. If the origination customer and destination customer were associated with the same regional peering facility, then e-mail notification **800** may specify the connection as regional peering. E-mail notification **800** may further specify the service class and protocol requested by the origination customer. Although not shown, e-mail notification **800** may include bandwidth information when, for example, the origination customer has selected priority service. Moreover, in some implementations, e-mail notification **800** may include a link to a web page that the destination customer may select to accept the peering connection.

In some implementations consistent with the principles of the invention, peering device **150** may cancel the origination customer's new peering connection request if the new peering connection is not established within a predetermined period of time, as indicated in e-mail notification **800**. In one implementation, the predetermined time period may be 45 days.

Returning to the processing described in FIGS. **5**A and **5**B, upon receipt of notification **800** from peering device **150**, the destination customer may access a predetermined network location using a user device. It is assumed hereafter that the destination customer accesses the predetermined network location using user device **130**D. In one implementation, the predetermined network location may include a web page. The destination customer may request the web page by, for example, typing in a URL associated with the web page or possibly selecting a link in e-mail notification **800**. In response, peering device **150** may cause an initial web page to be displayed at user device **130**D, such as web page **600** described above with respect to FIG. **6**. As set forth above, the

initial web page allows peering device **150** to identify and/or authenticate the destination customer.

Peering device **150** may identify and/or authenticate the destination customer (act **530**, FIG. **5**B). For example, peering device **150** may compare the user name and password entered by the destination customer to a list of authorized user names and passwords. If the destination customer's user name and password pair matches a user name and password pair from the authorized list, then peering device **150** may determine that the destination customer is authorized.

Peering device **150** may cause a peering connection acceptance graphical user interface to be presented to the destination customer at user device **130**D (act **535**). FIG. **9** illustrates an exemplary peering connection acceptance graphical user interface **900** that may be presented to the destination customer in an implementation consistent with the principles of the invention. As illustrated, graphical user interface **900** may include a list **910** of pending peering connections to the destination customer. Each entry in the list may identify the origination customer's connection information (e.g., the origination customer's SP, port identifier, the type of communication service employed by the origination customer, and the origination customer's connection identifier), the destination customer's connection information (e.g., the destination customer's SP, port identifier, the type of communication service employed by the destination customer, and the destination customer's connection identifier), the bandwidth requested (if any), the type of peering connection requested (e.g., extended peering (EXTPR) or regional peering (REGPR)), the communication protocol, and the status of the connection request. Each entry in list **910** may be associated with a radio button **920** that allows the destination customer to select the peering connection request that he/she wants to accept. Each entry in list **910** may be associated with additional or other fields, such as information identifying the origination customer who has requested the new peering connection.

Returning to the processing described in FIGS. **5**A and **5**B, if the destination customer accepts the origination customer's new peering connection request by, for example, selecting the appropriate radio **920** in graphical user interface **900** (act **540**, FIG. **5**B), peering device **150** may optionally notify the origination and destination customers that the new peering request has been accepted (act **545**). Peering device **150** may notify the origination and destination customers via any well-known technique (e.g., e-mail, facsimile, instant message, telephone, etc.).

FIG. **10** illustrates an exemplary e-mail notification **1000** that may be sent to the origination and destination customers in an implementation consistent with the principles of the invention. As illustrated, e-mail notification **1000** may specify the serial number that has been assigned to this new peering connection transaction and provide details regarding the new peering connection.

Similar to e-mail notification **800**, e-mail notification **1000** may specify the origination customer's connection information (e.g., from SP **120**A, port ID ABCD, and the origination customer's connection identifier DLCI **601**). E-mail notification **1000** may also specify the destination customer's connection information (e.g., to SP **120**G, port ID MNOP, and the destination customer's connection identifier VLAN ID **101**). E-mail notification **1000** may specify the type of connection to be established. In this example, an extended peering connection is to be established between regional peering facility **110**A located in DC and regional peering facility **110**C located in SJ. E-mail notification **1000** may further specify the service class and protocol to be used for the new peering connection. Although not shown, e-mail notification **1000** may include the bandwidth allotted to the new peering connection when, for example, priority service is to be used.

Returning to the processing described in FIGS. **5**A and **5**B, peering device **150** may cause the peering connection to be established between port ABCD (in the example above) associated with regional peering facility **110**A and port MNOP associated with regional peering facility **110**C (act **550**, FIG. **5**B). In essence, peering device **150** may forward the peering connection information to a regional peering facility, such as regional peering facility **110**A (the regional peering facility associated with the origination customer), which may establish a logical data path between port ABCD and port MNOP. Establishing a logical data path between two ports is well-known in the art and, thus, will not be described in detail herein. For example, the establishment of the logical data path may involve the transmission of a setup message from regional peering facility **110**A to regional peering facility **110**C and the transmission of a setup acknowledgement message from regional peering facility **110**C to regional peering facility **110**A. The setup message and setup acknowledgement message may be transmitted through a group of network devices (e.g., switches and/or routers) located between regional peering facilities **110**A and **110**C. The group of network devices may store an entry in a lookup table for the logical data path so that each network device is aware that traffic from the origination customer is to be forwarded to regional peering facility **110**C and traffic from the destination customer is to be forwarded to regional peering facility **110**A. Other techniques for establishing a logical path between ports ABCD and MNOP may alternatively be used.

Regional peering facility **110**A may notify peering device **150** when the peering connection has been established. Peering device **150** may then notify the origination customer and destination customer that the new peering connection has been established (act **555**). Peering device **150** may notify the origination and destination customers via any well-known technique (e.g., e-mail, facsimile, instant message, telephone, etc.).

FIG. **11** illustrates an exemplary e-mail notification **1100** that may be sent to the origination and destination customers in an implementation consistent with the principles of the invention. As illustrated, e-mail notification **1100** may specify the serial number that has been assigned to the new peering connection transaction and provide details regarding the newly established peering connection.

Similar to e-mail notification **800**, e-mail notification **1100** may specify the origination customer's connection information (e.g., from SP **120**A, port ID ABCD, and the origination customer's connection identifier DLCI **601**). E-mail notification **1100** may also specify the destination customer's connection information (e.g., to SP **120**G, port ID MNOP, and the destination customer's connection identifier VLAN ID **101**). E-mail notification **1100** may specify the type of connection that has been established. In this example, an extended peering connection has been established between regional peering facility **110**A located in DC and regional peering facility **110**C located in SJ. E-mail notification **1100** may further specify the service class and protocol to be used for the newly established peering connection. Although not shown, e-mail notification **1100** may include the bandwidth allotted to the newly established peering connection when, for example, priority service is to be used.

Returning to the process described in FIGS. **5**A and **5**B, if the destination customer does not accept the origination customer's peering connection request (act **540**, FIG. **5**B), peer-

ing device **150** may notify the origination customer of such via an well-known technique (act **560**).

In addition to establishing new peering connections, peering device **150** may allow customers to perform a number of other functions. For example, customers may modify and delete existing peering connections (e.g., move peering connections from one port to another; list, assign, modify, rename, and unassign ports; etc.); report on connections, ports, and failed login attempts; and manage user accounts. Peering device **150** may provide graphical user interfaces to customers for performing these functions, thereby allowing customers to perform these functions via a network connection.

CONCLUSION

Implementations consistent with the principles of the invention provide extended peering capabilities in a communications network. Extended peering allows a customer to peer with other customers regardless of where the other customers are located. In one implementation, the customer may build and maintain peering connections with other customers using, for example, web-based graphical user interfaces.

The foregoing description of exemplary implementations of the invention provides illustration and description, but is not intended to be exhaustive or to limit the invention to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. For example, while the above description focused on certain devices performing certain functions, it will be appreciated that, in other implementations consistent with the principles of the invention, other devices in system **100** may perform some or all of the functions described above.

While a series of acts has been described with respect to FIGS. **5**A and **5**B, the order of the acts may be varied in other implementations consistent with the invention. Moreover, non-dependent acts may be implemented in parallel.

It will be apparent to one of ordinary skill in the art that aspects of the invention, as described above, may be implemented in many different forms of software, firmware, and hardware in the implementations illustrated in the figures. The actual software code or specialized control hardware used to implement aspects consistent with the principles of the invention is not limiting of the invention. Thus, the operation and behavior of the aspects of the invention were described without reference to the specific software code—it being understood that one of ordinary skill in the art would be able to design software and control hardware to implement the aspects based on the description herein.

Further, certain portions of the invention may be implemented as "logic" that performs one or more functions. This logic may include hardware, such as an application specific integrated circuit or a field programmable gate array, software, or a combination of hardware and software.

No element, act, or instruction used in the description of the present application should be construed as critical or essential to the invention unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items. Where only one item is intended, the term "one" or similar language is used. Further, the phrase "based on" is intended to mean "based, at least in part, on" unless explicitly stated otherwise.

What is claimed is:

1. A method comprising:

receiving, using one or more processors and from a first customer via a web-based interface, selection of a first port, from a first plurality of ports, the first port being associated with the first customer and located in a first geographical region;

receiving, using one or more processors and from the first customer via the web-based interface, selection of a second port, from a second plurality of ports, the second port being associated with a second customer and located in a second geographical region different than the first geographical region;

receiving, using one or more processors and from the first customer via the web-based interface, selection of a communication protocol;

receiving, using one or more processors, a request, from the first customer via the web-based interface, to establish a peering connection, based on the selected communication protocol, between the selected first port and the selected second port;

sending, using one or more processors, a notification to the second customer, in response to receiving the request from the first customer, the notification including information identifying a first service provider associated with the first customer, information identifying a second service provider associated with the second customer, and information identifying the selected communication protocol;

detecting, using one or more processors, that the second customer has accepted the request to establish the peering connection after sending the notification; and

establishing, using one or more processors, in response to detecting that the second customer has accepted the request, the peering connection based on the received request.

2. The method of claim **1** where the request includes:

the information identifying the first service provider associated with the first customer, information identifying the first port, the information identifying the second service provider associated with the second customer, and information identifying the second port.

3. The method of claim **2** where the request further includes:

at least one of information identifying a class of service associated with the peering connection or information identifying a bandwidth.

4. The method of claim **1** where sending the notification includes:

sending the notification, to the second customer, via e-mail.

5. The method of claim **1** where sending the notification includes:

providing information relating to the request.

6. The method of claim **5** where the information, relating to the request, includes:

a connection identifier associated with the first customer,

information identifying the second port, and

a connection identifier associated with the second customer.

7. The method of claim **6** where the information relating to the request further includes at least one of:

information identifying a type of peering connection to be established,

information identifying a service class associated with the peering connection, or

information identifying the selected communication protocol.

8. The method of claim 1 further comprising:

providing a second web-based interface to the second customer, the second web-based interface allowing the second customer to accept the request from the first customer.

9. The method of claim 8 where the second web-based interface provides the information identifying the first service provider associated with the first customer, information identifying the first port, a connection identifier associated with the first customer, the information identifying the second service provider associated with the second customer, information identifying the second port, and a connection identifier associated with the second customer.

10. The method of claim 9 where the second web-based interface further provides at least one of information identifying a type of peering connection to be established, information identifying a service class associated with the peering connection, or information identifying the selected communication protocol.

11. The method of claim 1 further comprising:

notifying, based on detecting that the second customer has accepted the request to establish the peering connection, the first customer and the second customer that the request has been accepted.

12. The method of claim 11 where notifying the first customer and the second customer includes:

sending a notification, to the first customer and the second customer, via e-mail.

13. The method of claim 12 where the e-mail includes:

the information identifying the first service provider associated with the first customer,

information identifying the first port,

a connection identifier associated with the first customer,

the information identifying the second service provider associated with the second customer,

information identifying the second port, and

a connection identifier associated with the second customer.

14. The method of claim 1 further comprising:

notifying, after establishing the peering connection, the first customer and the second customer that the peering connection has been established.

15. A system comprising:

a network device comprising:

a memory to store instructions; and

a processor to execute the instructions in the memory to:

cause a web-based interface to be provided to a user device, the web-based interface allowing a first user to request that an extended peering connection be established between the first user and a second user,

receive selection of information from the first user, via the web-based interface, the selected information relating to the extended peering connection, and the selected information including information identifying a first port located in a first geographical region, information identifying a first service provider associated with the first port, information identifying a second port located in a second geographical region different than the first geographical region, and information identifying a second service provider associated with the second port,

send a notification, to the second user, that the extended peering connection has been requested, in response to receiving the information from the first user,

where the notification includes the information identifying the first service provider, the information identifying the second service provider, and information identifying a communication protocol associated with the extended peering connection,

detect that the second user has accepted the extended peering connection after sending the notification, and

cause the extended peering connection to be established between the first user and the second user, based on the received information selected by the first user via the web-based interface.

16. The system of claim 15 where the received information further includes the information identifying the communication protocol, and

where the first port, from which the extended peering connection is to be established, is associated with the first user, and the second port, to which the extended peering connection is to be established, is associated with the second user.

17. The system of claim 15 where the processor is further to:

notify the second user, in response to receiving the information from the first user, that the extended peering connection has been requested.

18. The system of claim 17 where the processor is further to:

assign information uniquely identifying the extended peering information prior to notifying the second user,

where the processor is to send the notification, to the second user, via at least one of e-mail, facsimile, or instant message, and

where the at least one of the e-mail, the facsimile, or the instant message includes the information uniquely identifying the extended peering information and the selected information.

19. The system of claim 15 where the processor is further to:

cause a second web-based interface to be provided to the second user, the second web-based interface allowing the second user to accept the extended peering connection.

20. The system of claim 19 where the processor is further to:

cause the second web-based interface to provide, to the second user, a list of pending requested peering connections, the list including the requested extended peering connection and at least one other requested peering connection to be established between the second user and a third user,

where the second web-based interface allows the second user to select the requested extended peering connection from the list of pending requested peering connections.

21. The system of claim 19 where the processor is further to:

notify the first user when the second user accepts the request, and

notify the first user when the second user does not accept the request.

22. The system of claim 21 where the processor is further to notify the first user via at least one of e-mail, facsimile, or instant message.

23. The system of claim 15 where the processor is further to:

notify the first user and the second user when the extended peering connection has been established.

24. The system of claim 23 where the processor is to notify the first user and the second user via at least one of e-mail, facsimile, or instant message.

25. A method comprising:

causing, using one or more processors, a graphical user interface to be provided to a user device, the graphical user interface allowing a first user to request that a peering connection be established between two ports, the two ports being selected by the user via the graphical user interface;

receiving, using one or more processors, information selected by the first user, via the graphical user interface, the information, selected by the first user, relating to the peering connection requested from the user device, and the information, selected by the first user, including information identifying a first service provider associated with a first port, of the two ports, and information identifying a second service provider associated with a second port, of the two ports;

sending, using one or more processors, to a second user associated with the second port, a notification of the peering connection in response to receiving the information selected by the first user,

where the notification includes the information identifying the first service provider, the information identifying the second service provider, and information identifying a communication protocol associated with the peering connection;

receiving, using one or more processors, a notification, from the second user, that the peering connection has been accepted after sending the notification; and

establishing, using one or more processors and in response to receiving the notification that the peering connection has been accepted, the peering connection between the two ports based on the received information selected by the first user via the graphical user interface.

26. The method of claim 25 where the communication protocol includes Internet Protocol,

where sending the notification includes:

sending the notification to the second user via at least one of e-mail, facsimile, or instant message,

where the at least one of the e-mail, the facsimile, or the instant message includes the received information.

27. The method of claim 25 further comprising:

causing a second graphical user interface to be provided to the second user, where the second user is notified via the second graphical user interface.

28. A system comprising:

at least one network device comprising:

a memory to store instructions; and

a processor to execute the instructions in the memory to:

receive, via a graphical user interface, selection of information identifying a first port associated with a first user,

receive, via the graphical user interface, selection of information identifying a first service provider associated with the first port,

receive, via the graphical user interface, selection of information identifying a second port associated with a second user,

receive, via the graphical user interface, selection of information identifying a second service provider associated with the second port,

receive, via the graphical user interface, selection of information identifying a communication protocol,

receive, from the first user, a request to establish a peering connection, between the first port and the second port selected via the graphical user interface, based on the information identifying communication protocol, the request comprising the information identifying the first port, the information identifying the second port, the information identifying the first service provider, the information identifying the second service provider, and the information identifying the communication protocol,

send a notification to the second user, in response to receiving the request to establish the peering connection,

where the notification includes the information identifying the first service provider, the information identifying the second service provider, and the information identifying the communication protocol,

detect that the second user has accepted the request to establish the peering connection, after sending the notification, and

establish the peering connection, between the first port and the second port, based on the received request and the communication protocol, when the second user has accepted the request to establish the peering connection.

29. The system of claim 28, where the processor is further to cancel the request when the peering connection is not established within a predetermined period of time.

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